VALUATION OF THE PROPERTIES

OF

PUBLIC UTILITY CORPORATIONS

"Noblesse oblige"
"Ad non ab finem"

BY

CHARLES GOBRECHT-DARRACH, M. A., C. E.
Mem. Am. Soc. C. E., Etc., Etc.
Hon. Mem. Am. Asso. Hospital Supts.
Hon. Mem. Inst. Operating Eng.

CONSULTING ENGINEER

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SHERWOOD
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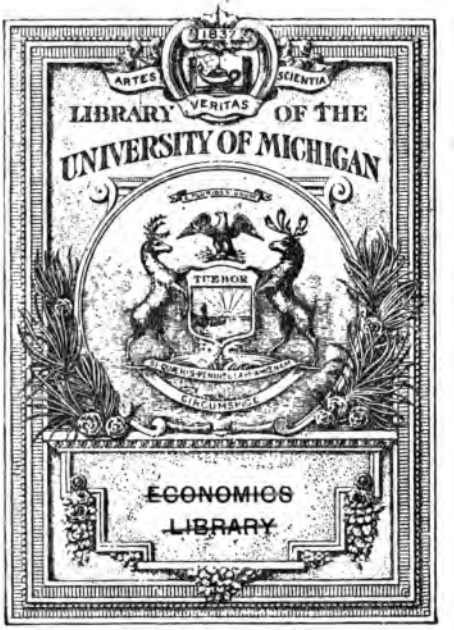
1913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CONTENTS

ILLUSTRATIONS

This edition is published for criticism—your discussion is earnestly solicited

Respectfully,

THE BRADFORD PRESS

VALUATION OF THE PROPERTIES

OF

PUBLIC UTILITY CORPORATIONS

This monograph, proposing a method for estimating the values of public service companies' properties, intends not to lay down an inflexible rule, but, avoiding hypothesis, and (as far as possible) the "personal equation," to suggest a THEORY, based upon the author's researches, upon his actual practical experience,* and upon his concept of our laws enacted in accord with the fundamental principles of the Constitution of these United States and with those of the several States.

Appraisals made in accord therewith have as foundation actual attainable FACT, and can be understood by an ordinary mind, although unlearned in scientific lore and untrained in sophomoric argument.

Such a theory should be capable of universal application for the appraisal of the value of properties owned and operated by private corporations, enjoying the franchise of the Commonwealth **for the common welfare,** and rendering service to a municipality in behalf of the Commonwealth itself.

On the other hand, we have the present scheme of appraisal, based on the so-called "Reproduction Method," in which (as the author understands the process) the cost to reproduce the old plant at the time of the appraisal is first estimated; from which there is deducted an estimate of the physical deterioration of the old plant (re-

*See Appendix, p. 39, et sec.

sulting in the present estimated structural value of the old plant); to this there is added "an estimated value of the created income of the old plant, *i. e., its going value.*"

To wit, cost of reproduction — deterioration + going value = value of the company's property.

Valuation, by this method, is based on three hypotheses, as follows:

First Hypothesis. (*Z*)

(a) That a dependable estimate can be made of the cost to construct and put into operation (at the date of the appraisal) a complete new plant, similar to that in existence; and, in this estimate, to make equitable allowance for the increase in cost of construction (over the cost of the plant constructed in the past), said increase being due to construction in paved streets congested with traffic, also to the gas pipes, electrical conduits and other underground existing structures, the results of which obstruct and render construction more costly.

(b) That the time required for building the new plant may be closely determined.

Second Hypothesis. (*X*)

That a value representing the condition of the depreciation of the old plant at the date of the appraisal can be determined, partly upon the age of the old plant and partly from its then observable condition; which values, being deducted from the hypothetical cost of reproducing the old plant at the date of the appraisal, will give the then value of the company's physical property.

Third Hypothesis. (*Y*)

That the amount of business coming to the new plant, and the time required for the development of that business, can be satisfactorily estimated.

Investigations made upon such foundation premises are fraught with uncertainty, and any approach, by such methods, to correct valuation is well nigh impossible.

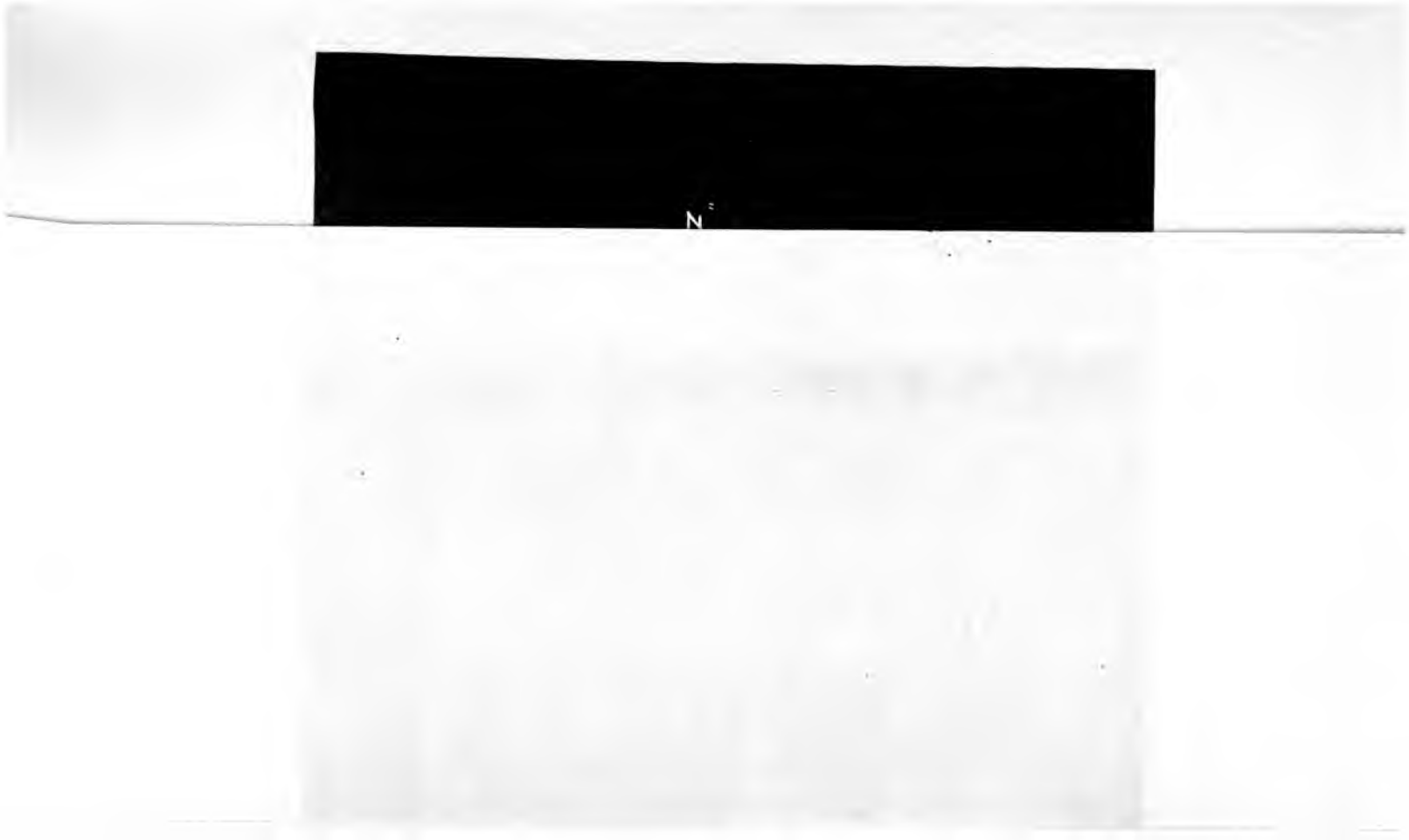
This statement seems to be corroborated by the fact that, for a given case, results obtained by reputable engineers vary beyond hope of reconciliation. In one instance of record, nine engineers, testifying to seven valuations **of one property,** varied from $49,500 to $151,330, or as from 1 to more than 3. (See p. 255 Proceedings Am. W. Wks. Assn., 1909.)

It is a remarkable fact that, in a large number of such valuations, examined by the author and specified in the following table and analytical diagram, the *deductions* for the HYPOTHETICAL DEPRECIATION about equal the *additions* for the HYPOTHETICAL GOING VALUE; the average of all the depreciations being, to the average of all the going values, as 46.76 is to 53.24.

ANALYSIS OF VALUATIONS BY METHOD OF REPRODUCTION.

A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.
		Z.	V.	$\frac{V}{Z}$	—X.	$\frac{X}{Z}$	+Y.	$\frac{Y}{Z}$	−	+
13	1	$182,720	$183,236	1.003	$32,100	.17[6]	$32,616	.17[9]	.....	.003
2	2	710,760	706,374	0.994	73,000	.10[3]	68,614	.09[7]	.006	.... .
8	3	115,060	116,934	1.016	8,400	.07[4]	10,274	.09[0]	.....	.016
20	4	1,321,100	1,344,632	1.018	156,573	.11[8]	180,105	.13[6]	.....	.018
12	5	6,441,117	6,263,296	0.972	740,333	.11[5]	562,512	.08[7]	.028	.....
19	6	1,736,392	1,787,367	1.029	137,000	.07[9]	187,976	.10[8]	.....	.029
4	7	432,874	447,103	1.033	48,489	.11[2]	62,718	.14[5]	.....	.033
9	8	89,800	93,130	1.037	9,500	.10[6]	12,830	.14[3]	.....	.037
17	9	523,500	545,868	1.043	29,640	.056	52,008	.09[9]	.....	.040
3	10	1,384,700	1,450,130	1.047	178,000	.12[9]	243,430	.17[6]	.....	.047
7	11	92,540	97,110	1.049	13,230	.14[3]	17,800	.19[2]	.....	.049
18	12	2,437,000	2,572,251	1.051	198,750	.08[2]	324,000	.13[3]	.....	.051
1	13	95,280	90,130	.946	24,010	.25[2]	18,860	.19[8]	.054	.....
14	14	564,027	598,831	1.062	115,019	.20[4]	149,823	.26[6]	.....	.062
16	15	90,179	83,522	.926	33,367	.37[0]	26,710	.29[5]	.075	
5	16	235,336	254,600	1.082	22,336	.09[5]	41,500	.17[6]	.....	.082
10	17	92,520	101,412	1.096	14,970	.16[3]	23,862	.25[9]	.....	.096
6	18	103,600	86,621	.836	25,940	.25[1]	8,961	.08[7]	.164	.....
15	19	435,026	533,102	1.223	38,846	.09[2]	136,922	.31[5]	.....	.223

Column "A" Item Nos. in table, p. 206 pro. Am. W. Wks. Assn., 1909.
Column "B" Item Nos. on diag.
Column "C" Reproduction Values, p. 206, Am. W. Wks. Assn., 1909.
Column "D" = The Award ="C"—"F" + "H" i. e. V=Z—X+Y.
Column "E" = % of "D" in terms of "C."
Column "F" = Depreciation, p. 206, Am. W. Wks. Assn., 1909.
Column "G" = % of "F" in terms of "C."
Column "H" = Going Value, p. 206, Am. W. Wks. Assn., 1909.
Column "I" = % of "H" in terms of "C."
Columns "J" & "K"=diff's ± between "G" & "I."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METHOD SUGGESTED BY THE AUTHOR

Instead of the "Method by Reproduction," the author proposes:

(1) Ascertain, from the Company's books or otherwise, the actual amounts expended upon the original plant, including the cost of organization, real estate, water rights, etc., etc., together with the cost due to extension, up to the time of the appraisal or condemnation; from this amount deduct unnecessary expenditures, either by reason of excessive prices, unnecessary work or purchases.

Call this amount "A."

(2) Ascertain the balance due the Company for reconstruction required by the municipality and beyond the control of the Company, also expenses due to so-called "Acts of God."

Call this amount "a."

(3) Ascertain the expenditures required (at the time of the appraisal or condemnation) to put the plant into a condition of perfect working efficiency, making due allowance for such actual deterioration (due to the age of the plant) as cannot then be made good.

Call this amount "B."

(4) Ascertain, from the Company's books, the actual annual gross revenues, from the date when the company started to serve the community to the date of condemnation, and construct curves similar to curves Z-a-g and Z-A-G.*

After an equitable rate per capita has been adjudicated, multiply the actual annual population by it, and construct curves similar to curves C-d and C-D.*

A comparison between the annual deficits and surpluses, together with interest, will show the amount chargeable against either the City or the Company, by curves similar to Z-E-F and Z-e-f.*

Call this debt of adolescence "C."

(5) Ascertain a sum representing the capitalization of the annual *net compensation,* to which the company is entitled for the administration of the plant, from the date of condemnation to the end of the franchise or contract, as may be adjudicated, based upon an adjudicated rate of increase of population and upon the adjudicated rates for service.

Call this sum "D."

The valuation would then be:

$$V = A + a - B \pm C + D.$$

*Diagram IX, facing page 34.

THE ARGUMENT

The Sovereign State, the Commonwealth, by charter and franchise, gives authority to corporations, public and private, to prosecute business within its territory, to use its highways and to have eminent domain. The STATE is supreme within its own domain, except when limited by obligations to its subjects as citizens of the United States. Questions at issue between the different States, their subjects, creatures and citizens, are determined by the Supreme Court of the United States.

The Sovereign State gives its franchise to both municipal and public utility corporations for the **benefit of itself,** *i. e.,* the community at large, and can enforce obedience to its demands, provided these do not infringe upon the rights enjoyed by its people as citizens of the United States.

A Sovereign State in bestowing its franchise is responsible to its own individual citizens, to its sister States, and also to each citizen of the United States, and is therein subject to and controlled by the IMPERIAL power of "the Constitution of the United States," *i. e.,* the concrete will of the Nation, in which the voice of each mature citizen has a right.

The financial inability of the State or a municipality to provide for her communal needs makes Public Service Companies necessary, and the lack of technical skill and business ability frequently make it expedient for the State or a municipality to obtain the aid of a Public Service Corporation.

When, in process of time, by growth in population and wealth, these disabilities are removed, the community naturally desires to assume the duties which, in its infancy, it could not perform.

The laws provide for such contingency, by empowering the community to abrogate its contract with its agent, the Public Service Company (which is the representative of the Commonwealth), and to appropriate its property and business by condemnation.

The Supreme Court of the United States has decided that, in such condemnation proceeding, equitable compensation must be made by the community to the company, which has used its own money, credit and skill, and which has also assumed all and sundry the numerous risks which otherwise would have been borne by the community which it serves, and for which it acts as agent.

In making equitable appraisements, too much stress cannot be put upon the fact that the company (although the representative of the Commonwealth) is *not* made the judge as to the amount of revenue it is to receive nor as to the rates which it may charge for its service; for, although its contract with the community may specify rates, the reasonableness of these rates can be reviewed by the court of the sovereign State itself.

In contemplating the organization of a Public Service Company, the first consideration is the *stability* of the business, and the second is the question, will it be *remunerative?*

Both questions depend primarily upon the equity of the judiciary and upon its freedom from local prejudice.

To make equitable appraisement, it is necessary to study and follow the history of a company from its inception.

An individual, believing in the possibility of remunera-

tion from the construction and operation of a certain public service plant, for example a *Municipal Water Works*, confers with other persons, and associates with himself, in a preliminary organization, men of ability, who subscribe funds for an expert examination, with estimates of cost and a report as to the probable revenues and as to the stability of the enterprise. If, then, it is decided to proceed, a State franchise and charter, with legal advice, is obtained, and the permanent organization is perfected.

An ordinance of the municipality, embodying certain *contract* rights and limitations, is obtained, and the company is then ready to set about construction.

The company then issues bonds, bearing interest, and redeemable at certain periods. The services of a responsible broker are engaged to market these bonds; the money obtained to be used for construction of the plant and for the payment of interest on the bonds during the adolescence or non-remunerative period of the enterprise.

These operations (which, in the case of a private company, are as essential and as legitimate as the construction of the works) cost money, which must be paid by the promotors, and must be reimbursed to them by the consumers, if the company is to survive.

Detailed reconnaissance, plans and estimates are made, real estate and water rights purchased and contracts for construction perfected. The actual physical work is then performed, and the company is ready to serve the public.

In the early years of business, revenues are derived from only a portion of the patrons, and the main reliance of the company for revenue is upon the sums to be paid by the municipality for the company's services in supplying the city's public needs.

If the city should build and operate its own plant, all the above deficits would be PAID FOR OUT OF TAXATION.

If the rates to be charged by the company, say for water supply, are made such that, *with the full expected volume of business,* they shall merely cover expenses and interest, and insure a reasonable profit to the company, then the company must evidently be permitted to charge *higher* rates until the debt of adolescence has been liquidated, *after which* the company may properly be restricted to the original rate.

For instance, suppose that the population, occupying the territory to be supplied by the company's plant, doubles in forty years, and that the revenue required to cover expenses, etc., can be furnished by a rate of $5.50 per capita upon the entire present population. It is shown* that in this case a charge of $5.75 per capita for about fifty-eight years will be required, in order to pay the debt incurred during the period of adolescence lasting twelve years.

It frequently happens that the municipality finds itself able and desirous to dispossess the company immediately after its period of adolescence.

A careful consideration of this critical period is most necessary, in order to avoid unfair treatment of the company.

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*Diagram IX, facing page 34.

DETERMINATION OF RATES

The amount of money that can be judiciously expended in the construction of a plant depends upon the dependable revenue which it returns.

The courts have decided that the rates to be charged by a public utilities company (*i. e.*, by the agent of the Commonwealth) must be both equitable to the company and reasonable to the consumers.

The plant, therefore, must be so designed that a COLLECTIBLE RATE is synonymous with a PROFITABLE ONE.

As an example, the revenues (per capita of population) of a large number of municipalities, supplied with clear and potable water, and ranging in population from 100,000 to 3,000,000, are very uniform; and such municipal charges form a satisfactory basis from which (by adding to it the unavoidable additional expense which we will show to be inseparable from private management) we may fairly estimate the rates which a private company may properly be permitted to charge.

These rates, capitalized, give a standard cost which can be judiciously expended on the plant of a Public Service Company.

Companies constructing plants which cost more than this standard must be content with a lower rate of profit, and may even find their operation resulting in loss, unless it can be demonstrated that the greater cost was absolutely unavoidable, in which case the State may properly authorize a higher rate of charge.

The company, *i. e.*, the STATE, takes the place, as agent, of the city or town in that particular service assigned to it, uses its own money, and assumes all the risks which otherwise would have been borne by the city; it is therefore entitled (so long as it performs its duties) to as full protection as if the city itself were providing the service.

The city must also remunerate its agent as justly as it would any other contractor, and must make to it the same allowances as it would make to itself. In this connection, it must be borne in mind that, if the city performed the delegated service, it would have certain advantages which it cannot delegate to its agent, the Public Service Company, and which can be equalized only by authorizing the company to charge higher rates than the city would require.

If the rate, to be charged by the City operating its own works, would suffice to cover interest on the investment, a sinking fund to meet the investment, operating expenses and repairs, then the *company's* rate should be sufficiently higher to cover also the following necessary outlays, which the city does not have to meet:

First. The expense necessary in the organization and financing of the public service company.

Second. Taxes of all kinds—municipal, State and national.

Third. Legal expenses required to protect the property, as well as insurance against unavoidable accident.

Fourth. Compensation for loss of rents, and for the cost of the collection of delinquent rents.

The city collects by lien on the real estate for unpaid rates; whereas in the case of the company, the debt is against the water taker and must be sued out like any other common debt.

Fifth. Compensation for reconstruction made necessary by the action of the municipality in changing its lines and grades.

Sixth. The city can, and does, by ordinance, require that *every* property shall pay a certain rental; and if these rentals are insufficient, it pays for the deficit out of taxation.

Seventh. The company must solicit patronage, and it has practically no redress from theft of water.

Eighth. The city collects annually in advance. The company must collect monthly in advance, which is more costly and often causes loss of patronage.

Ninth. The city can and often does require the individual realty owner to pay for a part or all water supply mains.

Tenth. During the adolescence of the business, the rentals will be insufficient to meet all the costs upon which the rates are made.

This deficit, if the city owned the plant, would be paid out of taxation, and should similarly be reimbursed by the city to the company.

Eleventh. The company must pay a profit, in order to induce the investment of capital for the general conduct of the business and to cover its risks.

Item first. The expenses necessary in the promotion, organization and financing of the company should in equity be added to the capital cost, and provided for in the annual revenue, as it is as proper a charge against the physical plant as is the salary of the civil engineers or of the superintendents during construction.

Corresponding expenses, paid by a municipality, are rarely if ever charged to a plant constructed by it, these costs being covered by the salaries of municipal officials, with their staffs, from the Mayor and Councils or Commissioners, the Director of Public Works, to the City Controller, Treasurer and Solicitor, etc., etc. This cost of general administration is never, to the writer's knowledge, segregated and charged to particular activities.

Item second. Taxes of all kinds, municipal, State and national, should be reimbursed to the company. The city has no such obligations, and (as the company is held to be the agent of the city) it should be relieved from the burden.

Item third. Legal expenses, required to protect the company's property and franchise, as well as insurance against fire, flood, and unavoidable catastrophe (or so-called "Acts of God") are met, in a municipality, by special appropriation; and, like the salaries and expenses of its general administrative officials, are paid from taxation, and do not appear as an item of expense against the cost of the physical plant or its operation; these expenses should also be reimbursed to the company.

Items fourth to eleventh need no further elucidation.

On the other hand, the company must construct and operate in accordance with the best practice of the known state of the art, and with skill and economy.

To do business economically the company must be secure in its position, and must be absolutely sure that, should the city elect either to take the works itself or to delegate its powers and privileges to another agent, the retiring company shall receive full value for its services and property.

STANDARDS

Under municipal ownership and operation, the city's revenue, per capita of population, represents a certain interest, which, if capitalized, represents the proper per capita cost of the plant. In cities using a *clean* and *potable* water, and having populations from 10,000 to 3,000,000, this revenue is very nearly uniform, as already observed. In such cities the revenue is sufficient to pay for the items heretofore noted as making the necessary city rates (so that the price of the service can be reduced to a *standard*).*

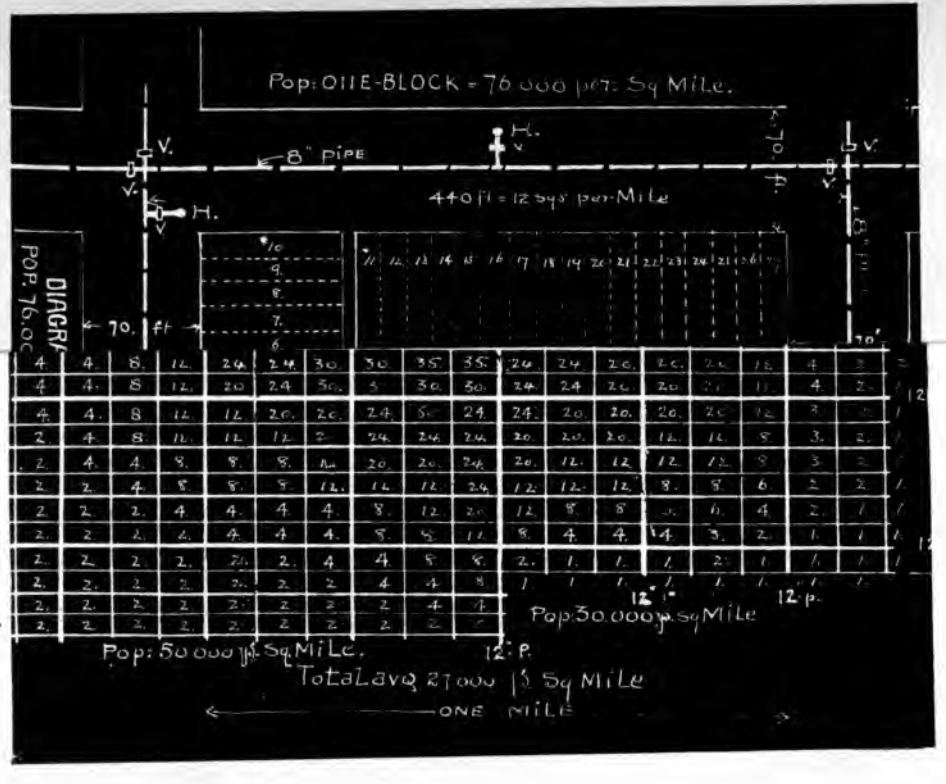
It is also a *fact* that this standard of revenue, per capita, is a practically fixed percentage of the actual construction cost of the necessary water works plant, per capita; and this is substantiated by data respecting works covering populations varying from 10,000 to 3,000,000 (*in any case that a public service company would judiciously assume*). Practice and experience have thus established a *standard value* per capita for water works plants.

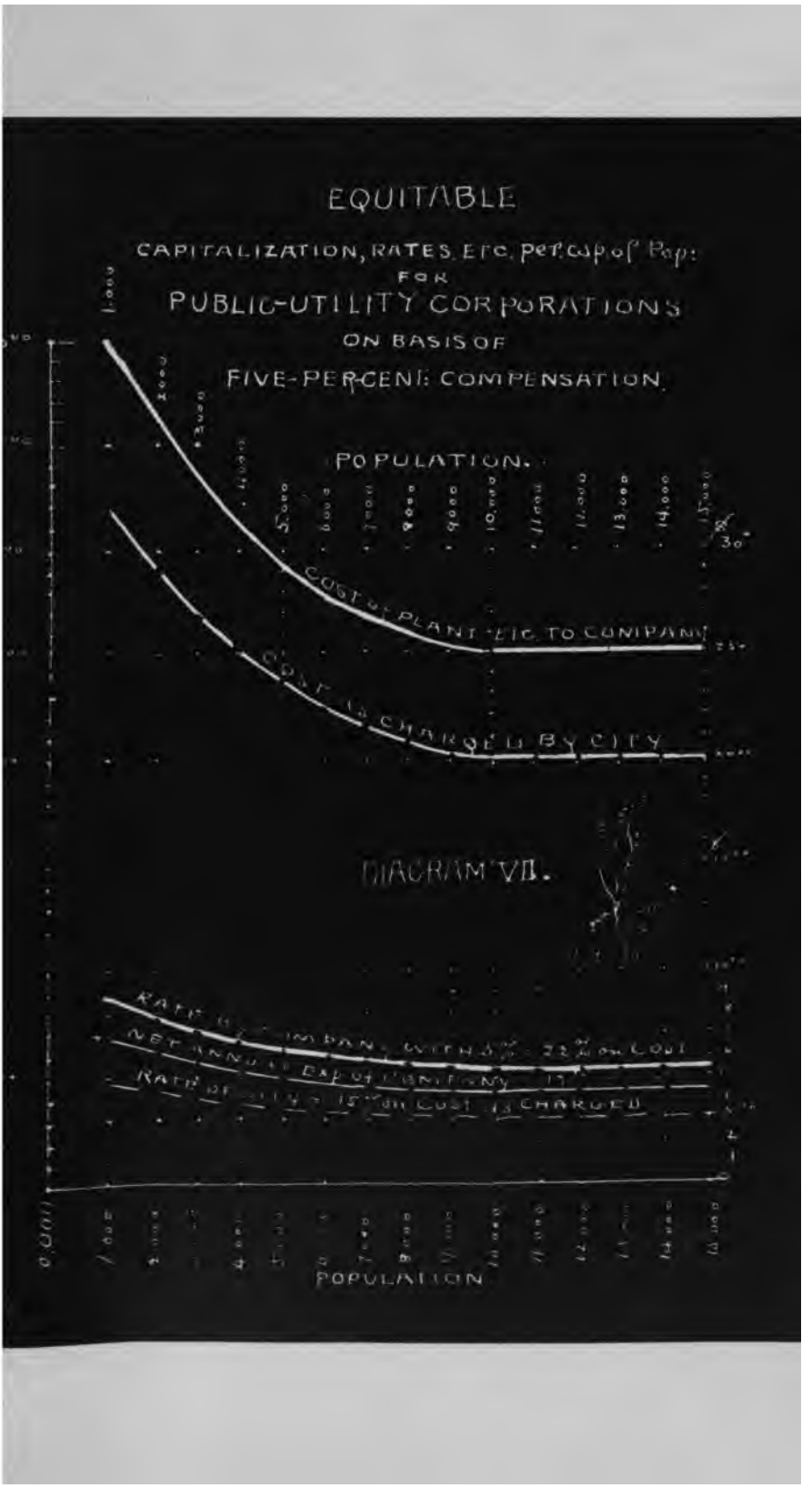
For populations less than 10,000, the density, as an almost universal rule, is less,† and consequently requires a greater mileage of supply mains‡ per unit of population, and the cost, for administration and for fire protection, is

*Diagram II.
†Diagrams IV, V, VI.
‡Diagram III.


MEMPHIS T
ROCHESTER NY
KANSAS CITY MO
WASH D C
COLUMBUS O
PROVIDENCE R I
SEATTLE W
JERSEY CITY N J
LOS ANGELES CAL


MILES OF PIPE
0
100
200
300
400
500
600
700
800
900
1000


Pop: ONE-BLOCK = 76 000 per Sq Mile.
V.
8" PIPE
H.
4401 ft = 12 sqs per Mile
DIAGRA
POP. 76.0C
70. ft
Pop: 50 000 per Sq Mile.
12: P.
Pop: 30.000 p. sq Mile
12 p.
Total Area 27000 ft Sq Mile
ONE MILE


EQUITABLE
CAPITALIZATION, RATES, Etc. per cap of Pop:
FOR
PUBLIC-UTILITY CORPORATIONS
ON BASIS OF
FIVE-PER-CENT: COMPENSATION.
POPULATION.
COST OF PLANT, ETC TO COMPANY
COST IS CHARGED BY CITY
DIAGRAM VII.
POPULATION

proportionately greater than in the larger plants, so that the cost of the smaller plants and their operation is correspondingly increased, justifying higher rates. Experience has very fairly indicated what these rates should be.§

Should the municipality elect to sever its relations with the company the plant should be valued, and adjustments made to cover such of the deficiencies noted as have not been included in the rates, including the losses during the period of the plant's adolescence, together with compensation for the conduct and general management of the business.

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§Diagram VII.

VALUES

The Courts have held that values rule, and not of necessity the cost of the property.

The COST, to produce a given plant, varies *inversely* with the ability and integrity of the constructor, whereas the VALUE varies *directly* with the ability and integrity of the constructor.

Hence, the amount of money actually expended to construct and install any particular plant (or the cost to duplicate it) cannot always be the equitable criterion, either for a fair rate of charge for service or for the valuation of the plant.

The comparative VALUE of a plant is what the plant will earn—is the net profit which can be obtained from it for equivalent service.

Take, for instance, two railroads between the same terminals; one of them may have unfavorable gradients and difficult alignment; it may be expensive in operation and maintenance and may have been costly in construction; while the other may have favorable gradients and easy alignment, may be inexpensive in operation and maintenance, and may have cost less for construction.

Or, a plant may have been built on immature judgment. The writer recalls an instance in point, while engaged in the location of a part of the (now) Chesapeake and Ohio Railroad, where, in but 15 miles, a previous location was so revised as to eliminate 8,000 degrees of curvature in the alignment, and reduce the maximum gradient from 1% to 2/3%, without increasing the length of the line, and at a reduced cost for construction; at the same time changing from a side hill to a valley location.

In each illustration the LESS costly plant was by far the MORE VALUABLE.

The charter and franchise, from the soverign State, have been granted to the public utility company for the *benefit of the community*, and the company is unhampered as to the methods of construction and operation. The State is therefore entitled to a service based upon AN APPROACH to the best the "state of the art" can provide, at a price that will NOT STIFLE INVESTMENT by private parties.

Returning to the example of the two railroads with the same terminals: If the charges for service are based upon actual cost of construction, operation, etc., the better and more economically constructed railroad could divert all the business from the more costly road, at competitive charges for service but little less than those required to remunerate the more costly road; but, as the less costly road may charge the same as the other, the community that gave the franchise suffers by having to pay, on both roads, the higher rates which the poor road must be allowed to charge.

To be equitable and to protect itself, the State must *ex necessitate* establish a **rate of charges independent** of the incidental cost of the public service company's plant. Such a STANDARD would provide net revenues in proportion to the skill and ability used in the design, construction and operation of their respective plants.

A standard charge for service, and a standard value of plant, are co-relative, one is a percentage of the other.

Such a standard for WATER SUPPLY COMPANIES (as has heretofore been indicated) can be determined from voluminous municipal public records; and the VALUE of any special plant can be closely approximated by a comparison with a standard specification.

SPECIFICATION

FOR

A STANDARD WATER WORKS PLANT

A standard water works plant (with which comparisons for appraisements are to be made) may be briefly summarized as follows: The water supplied must be clear and potably pure, and served at an average rate, per capita, of not less than 125 gallons in 24 hours, and at a maximum of 200 gallons per capita during the peak of the load, with a pressure of from 25 to 65 pounds per square inch in the street mains adjacent to the consumers.

The distribution system must be so designed that additional feeder mains will enable it to maintain the specified pressures and capacity for a population with a density of 70,000 per square mile.*

N. B. In cities where a fire pressure is furnished, there should be an increased capitalization as well as an increased rate; and, in communities where the specified 125 gallons per capita is insufficient for municipal requirements, the supply must be proportionately increased.

*For the standard or reference plant, the city area is subdivided into rectangular blocks, with parallel main streets, 440 feet between intersections, and having one sub- or intermediate street in each block. The sub-streets to have 4-inch pipe and the main streets (1,320 feet apart, parallel and at right angles) to have 12-inch pipe. All other main streets to have 8-inch pipe.

The minimum density of population provides for one dwelling, or say six persons, in one main block. See Diagrams IV, V and VI, facing page 22.

The system must be furnished with water gates or valves of standard pattern, enclosed in boxes with cast iron manholes and covers, and of sufficient size to admit of inspection and repairs. The gates must be so numerous that not more than two city blocks, or approximately 880 feet, will be deprived of water in event of a necessary shut-off.

Pipes are to be of cast iron, class "C," or first quality cement pipe laid with at least 48-inch *cover.*

Fire hydrants are to be of standard make, each provided with a gate on the supply from main, and not more than 440 feet apart, or say not fewer than 12 to the mile.

Reservoirs, for artificially purified, spring or artesian waters, must be covered, for protection from the sun and from the surrounding atmosphere.

Supply apparatus shall be of such style as to give the most efficient service and economy, taking into consideration the combined expense of first cost, maintenance, fuel, wages, insurance, depreciation, and interest on investment.

In pumping plants, at least one spare pumping unit, or sufficient adjacent reservoir capacity, should be provided to guard against accident, and equivalent provision must be made in gravity plants.

Buildings shall be fireproof, and all structures shall be of permanent design and materials.

STANDARD RATES AND COSTS

DIAGRAM II* shows the per capita revenue of the water supplies of 30 cities in the United States in various localities, from the Great Lakes to the Gulf of Mexico, and from the Atlantic to the Pacific Coast. These cities are served in all sorts of ways, and vary in population from nearly 3,000,000 (the City of New York, *i. e.,* Manhattan and Bronx Boroughs) to but 10,000.

The data indicate an average annual revenue of over $3 per capita of population; which, on a basis of $20 per capita as the COST OF THE PLANT, returns to the municipality (to cover operation, maintenance and repairs), approximately 7½% of $20..... $1.50
and, to cover interests on costs of construction, etc., together with sinking fund deposits to pay for the cost of construction, approximately 7½% of $20.. 1.50

making as a total the above mentioned 15% of $20 $3.00

These revenues per capita (obtained from OFFICIAL PRINTED REPORTS) will average OVER $3.00 per capita of the population; notwithstanding that, in many cases, the major cost of the distribution system is **paid directly by the real estate owners, and is not included in the cost of the plant covered by the municipal loans.**

*Diagram II, facing page 22.

Investigation will demonstrate that such plants, serving populations of over 10,000, cost—for construction, real estate, water rights, etc.—approximately **$20 per capita of the population in the individual unit of population for which the facilities of the water supply have been provided.** As a rule, those plants which are less costly in construction per capita require greater annual expenditure, thus balancing the total annual expense of the more costly plants; while water power and gravity supply plants (generally most expensive for interest charges and sinking fund deposits) are less costly for operation, maintenance and repairs.

From these *established facts,* obtained from OFFICIAL REPORTS OF MUNICIPALITIES, we may deduce reliable criteria and STANDARDS with which the properties of public utility corporations may be compared, in order that they may be properly valued.

To cover the expenses of promotion, organization, interest, legal charges, etc. (not provided for in the $3 charge by the municipality, or estimated in the cost of its plant at $20 per capita), there should be added, in the case of a private company, at least 25%, or $5, making the standard capitalization for the public service company $25 per capita of the POPULATION PROVIDED WITH SUPPLY FACILITIES; and, upon such increased capitalization, the rates of charges (to provide reasonable profit to the company for serving the public) can be reasonably predicated.

If, from these data, we can reasonably assume that the standard private water works plant, for population over 10,000, will cost very approximately $25 per capita for a complete installation, the equitable rates can be based on the following revenue:*

*Diagram VII, facing page 22.

For cost of operation, maintenance, repairs, 4% interest on bonds,* and the sinking fund deposits, 15% on $25	$3.75
Insurance and litigation, taxes, etc., 1½% on $25	0.37½
Amortization not provided for in repairs, etc, ½% on $25	0.12½
Net annual expense, per capita, without profit	$4.25
Say: 5% for annual dividends, or compensation for services, 5% on $25	1.25
Total revenue required, per capita, per annum, 22% on $25	$5.50

*If the interest rate on its bonds, paid by the company, exceeds 4%, the compensation will be less. The rate of interest on bonds issued by a public utilities company, is almost invariably higher than that on a municipal loan, which fact must be considered in fixing the allowable rate of net profit, which will vary also with the custom in the geographical location of the plant.

OBSOLESCENCE AND AMORTIZATION

A public service plant is not supposed to die or to become superannuated, but to be kept constantly in a state of efficiency and economy, up to the requirements of the demanded service.

OBSOLESCENCE of parts of the plant, due to insufficiency or inefficiency, is met by the increased capitalization, on the basis of increased population.

AMORTIZATION, except that of wrought iron or steel stand pipes and pipes underground, does not occur in properly conducted and carefully arranged plants.

Incidental repairs of parts are made from time to time as required; the buildings, apparatus, filters, reservoirs, dams, etc., are (in properly operated plants) always kept in prime condition, and the expense is charged to operation and repairs.

STEEL OR WROUGHT IRON STAND PIPES can be kept indefinitely in first-class condition, this expense also being charged to repairs.

CAST IRON PIPES, of proper thickness (say Class "C), can, at slight expense, be cleaned of tubercles, from time to time, and their useful life thus prolonged indefinitely.

The life of WOOD STAVE PIPE and of STEEL and WROUGHT IRON PIPE depends upon the material and method of their construction, and upon the nature of the soil in which they are laid, as well as upon the character of the water they carry.

It follows that deductions for amortization should be made only after a careful examination and after an estimate of the cost of putting the plant into prime condition. This amount should properly be deducted from the award, not as of the value of the plant for capitalization, but on account of repairs not performed.

COMPENSATION FOR ADOLESCENCE

The adolescent period (*i. e.,* from the time the company commences to get patrons until the entire population in the area covered by the company's plant have become customers), during which the revenues of the company are insufficient to cover its various expenditures and its equitable compensation, can be gradually reimbursed by increasing the basis for the rate of charges above the standard for a period of years such that the annual surpluses (obtained by using the compensating rate after the adolescent period) will liquidate the annually increasing debt of adolescence due to the previous deficits and the interest charges.

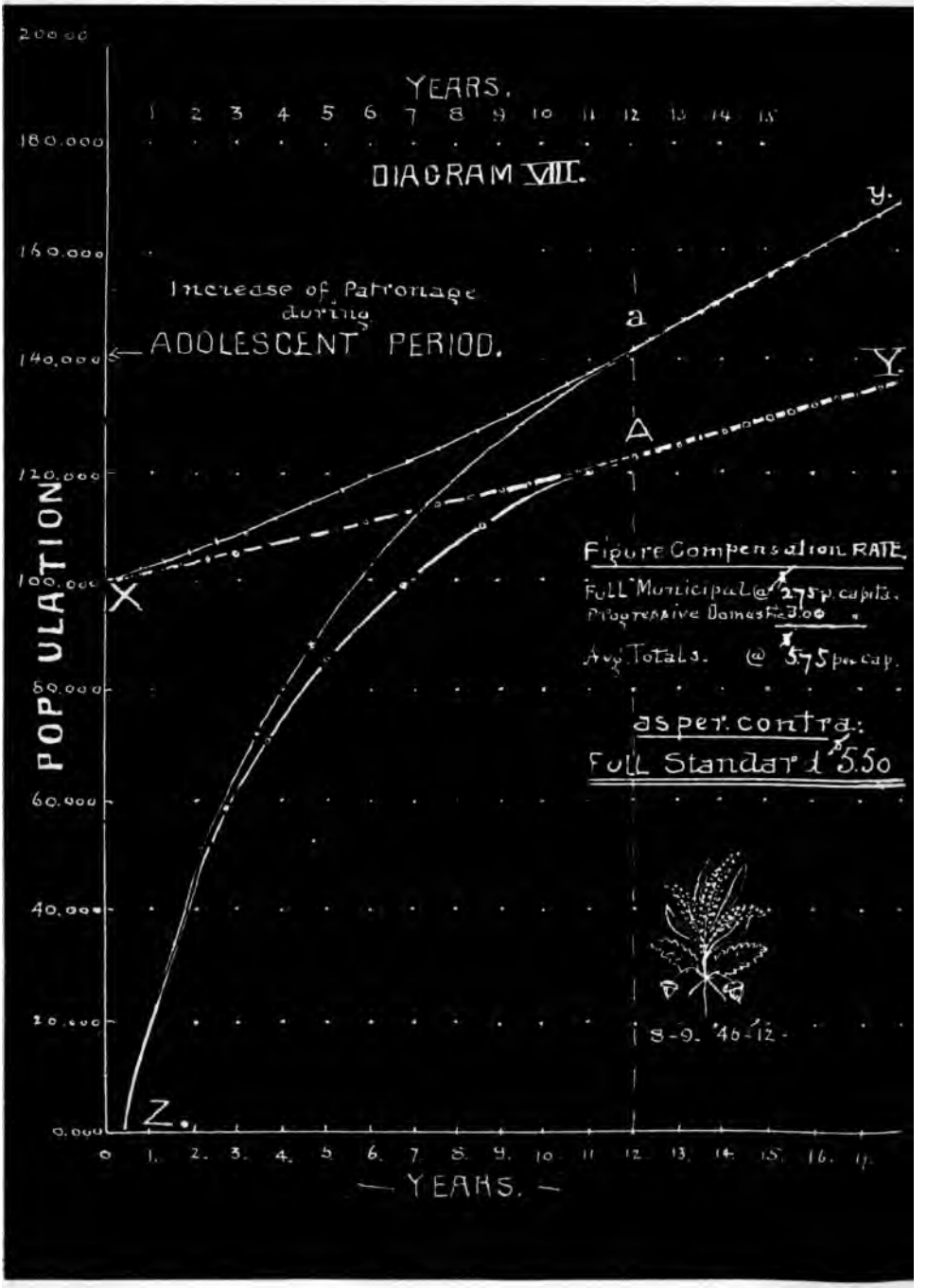
The company carries this debt of adolescence until it is finally liquidated, after which the basis of charges should be reduced to the equitable standard rate.

Should the municipality terminate its *contract* relations with the company, either by allowing another company to enter its territory and share its business, or by building and operating a competing plant itself, or by condemnation and purchase of the incumbent company's property, prior to the termination of its franchise; then, in equity, the municipality should make full restitution for the entire property, including not only the physical value and real estate, but also the debt of adolescence and the present capitalized value of the allowed net profits up to the time limit of the contract or franchise, as may be adjudicated.

The period for liquidation of the debt of adolescence depends:

First. Upon the excess of the *compensating* rate per capita over the *standard* rate per capita.

Second. Upon the rate of growth of the population provided with the company's water pipes, etc.


YEARS.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
DIAGRAM VIII.
Increase of Patronage during ADOLESCENT PERIOD.
POPULATION
200.000
180.000
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
X
Y
Z
a
A
y.
Figure Compensation RATE.
Full Municipal @ 2.75 p. capita.
Progressive Dames Fee 3.00
Avg. Totals. @ 5.75 per cap.
as per contra:
Full Standard 5.50
8-9. '46-12-
0 1. 2. 3. 4. 5 6. 7 8. 9. 10 11 12. 13. 14. 15. 16. 17.
— YEARS. —

Diagrams VIII and IX illustrate the facts in relation to this subject, considering a city with initial population of 100,000.

DIAGRAM VIII.

Points a and A, indicate the termination of the period of adolescence, here assumed as 12 years.

Curve X-a-y shows an annual increment of population when it DOUBLES IN 24 YEARS.

Curve X-A-Y shows the same when the population DOUBLES IN 40 YEARS.

Curves Z-a and Z-A shows an assumed annual relative increase in number of consumers (other than the municipality itself) during adolescence.

DIAGRAM IX.

Curves X-a-y, X-A-Y, Z-a and Z-A, correspond with the similarly lettered curves on Diagram VIII.

Curves B-g and B-G represent the annual revenues from an assumed *compensating* rate of $5.75 per capita of total population per annum.

B-g: for population doubling in 24 years.

B-G: for population doubling in 40 years.

Curves C-d and C-D represent the annual revenues from an assumed *Standard* rate of $5.50 per capita in population.

C-d: for population doubling in 24 years.

C-D: for population doubling in 40 years.

Curves Z-a-g and Z-A-G show the annual revenues from the compensating rate, commencing with the starting of the plant, during and subsequent to adolescence.

Z-a-g for population doubling in 24 years.

Z-A-G for population doubling in 40 years.

Curves Z-e-f and Z-E-F show the gradually increasing debt* of adolescence and its gradual liquidation.

On curve Z-e-f, when the population doubles in 24 years, LIQUIDATION occurs in 30 years.

On curve Z-E-F, when the population doubles in 40 years, LIQUIDATION occurs in 58 years.

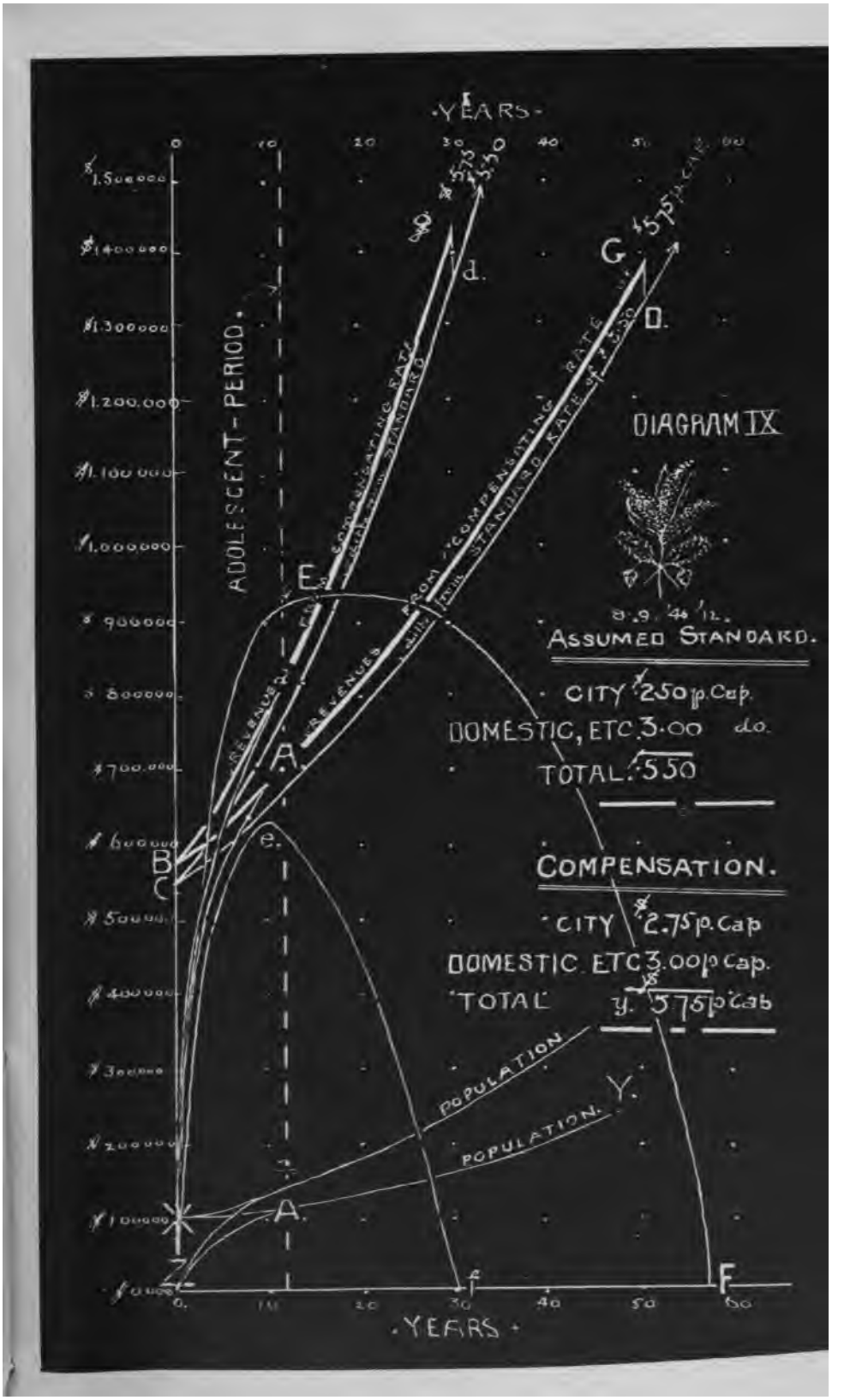
It is to be noted that the annual revenues, at the date of liquidation, are practically the same in both examples; also that the maximum debt of adolescence in each occurs at about one-third of the entire period from the beginning to the date of liquidation.

On curve B-g, the annual revenues from the *compensation* rate equal $1,437,000 at 30 years.

On curve B-G, they equal $1,390,000 at 58 years.

These curves are given merely as examples of the method. In practice, actual conditions would be substituted.

*Interest figured at 4% per annum.


YEARS
ADOLESCENT-PERIOD
REVENUES
REVENUES
POPULATION
POPULATION.
YEARS
DIAGRAM IX
8.9.44/12.
ASSUMED STANDARD.
CITY 2.50 p. Cap.
DOMESTIC, ETC 3.00 do.
TOTAL 5.50
COMPENSATION.
CITY 2.75 p. Cap
DOMESTIC ETC 3.00 p Cap.
TOTAL 5.75 p Cap

METHOD OF APPRAISAL

The cost of "reproduction" (involving the building of a new plant, exactly like the existing one, in a city with paved and congested streets, with a network of underground structures) will of course be greater (by an amount B) than has been the actual cost of the existing plant up to the time of appraisal (*unless the city has failed to reimburse the company for any additional expense, by reason of changes of plan by the city, over which the company has had no control*).

The city should not be charged with amount B, because the company is the AGENT of the city.

Considering that the SALE of the property is FORCED ON THE COMPANY by the municipality, the actual LEGITIMATE cost of the entire plant, as it was constructed, whatever it may have been, together with the cost of promotion and organization, should, in equity, be its appraised value, modified by a deduction of the cost to put the plant into prime condition, which is a debt on account of unfulfilled operating expenses.

There should also be paid to the company the unpaid debt of adolescence* at the time of the transfer, on account of operating expenses.

In addition to the net sum of the above accounts, there should be paid the company, for anticipated compensation for services, the present capitalization of the annual equitable net percentages for services rendered *up to the time limit of the franchise or the contract,* as may be adjudicated.

*Diagram IX, facing p. 34. Curves Z-e-f and Z-E-F.

MODIFICATIONS.

The company may:

First, have constructed a temporary plant (to be supplanted by one with enduring structures and more economical apparatus) but able to supply water of the requisite purity, quantity and pressure.

> In this case, the standard rate of charges should not be diminished, since the service is up to the standard. The valuation of the plant would be reduced below the standard, but with a liberal allowance to the company.

Or, *second,* the company may have purchased real estate or water rights, and may have constructed works for contemplated future needs.

> In this case, a liberal estimate should be added to the standard, for the valuation of the plant in question, to cover the expenditures for future business; but the rate of charges should not be increased above the standard.

Or, *third,* the environment may have absolutely required a greater than customary outlay.

> In this case, the rates to be charged should be greater, in order to increase the revenue required to sustain the necessarily increased cost of the plant, which would also be credited with a greater value than the standard.

CHARLES GOBRECHT-DARRACH,
5818 Willows Avenue,
Philadelphia, Pa.

September 8, 1912.

APPENDIX

PRACTICAL EXPERIENCE

OF THE AUTHOR

APPRAISALS

ANNISTON, ALA.

Electric Railroad System and Electric Lighting Plant.—Examination, Appraisements and Reports.

ALANTA, GA.

Atlanta Traction Company.—Examination, Appraisement and Reports.

Atlanta City Electric Railroad.—Examination, Appraisement and Report.

Atlanta, West End and McPherson Barracks Electric Railroad.—Examination, Appraisement and Report.

Grant Park Electric Railroad.—Examination, Appraisement and Report.

BALTIMORE, MD.

Electric Light and Power Company.—Examination, Appraisal and Report.

CHATTANOOGA, TENN.

Electric Railroad System.—Examination, Appraisement and Report.

CHICAGO, ILL.

North Chicago Traction Company.—Examination, two Appraisements and Reports.

SIOUX CITY, IOWA.

Riverside Park Electric Railroad.—Examination, Appraisement and Report.

MILLVILLE, N. J.

Examination, Report and Valuation of Property of the Millville Water Company.

MOUNT VERNON, SKAGIT COUNTY, WASHINGTON.

Mt. Vernon Water and Power Company.—Examination, Appraisal and Report.

LEGAL CASES

Anderson *vs.* Philadelphia and Reading Railroad.—Case to Defend Case of Wreck on Pickering Valley Railroad at Pennypacker Reunion.

Borough of Ridley Park *vs.* Chester and Darby Traction Company.—Case to Prevent Encroachment.

Crozier *vs.* Chester Water Company.—Case to Claim Damage for Leaking Reservoir.

E. S. McGlue *vs.* City of Philadelphia.—Suit to Defend on Measurement of East Park Reservoir.

Frank McLoughlin *vs.* Beech Creek R. R.—Case to Recover on Remeasurement and Reclassification.

Izzard *vs.* May's Landing Water Power Company.—Case to Claim for Use of Water.

Jutte & Foley *vs.* City of Altoona.—Suit to Recover on Reclassification Flood Water Channel.

Mt. Vernon W. & P. Company *vs.* City of Mt. Vernon.

Philadelphia Water Department, 1875 to 1884.

Schliechter, Schumm & Company *vs.* Surety Life Insurance Company.—Elevator Wreck Case, to Defend Breach of Contract.

Union Traction Company *vs.* Ogontz Power Station.—Case to Defend for Use of Water.

Etc., etc., etc.

PROFESSIONAL REPORTS—PAPERS AND DISCUSSIONS, ETC.

The Railway of the Orient.—Constantinople to Western Extension of India Railways and China.—Provisional Report.

Monograph on Valuation of the Properties of Public Utility Corporations.

Paper on Mechanical Installation in Office Buildings.

Paper on the Design, Installation and Maintenance of the Modern Community Building.

Papers and Discussions on Water Purification.

Papers and Discussions on Sewage Purification.

Papers and Discussions on Reinforced Concrete.

Papers and Discussions on Wood Water Pipe.

Papers and Discussions on the Proper Dimensions for R. R. Culverts.

Tests and Paper on Friction of Water in Clean and Foul Pipes.

Tests and Paper on Comparative Value of Compound *vs.* Simple Engines for Office Buildings.

Tests and Report on Condensation in Steam Pipes and Comparative Value of Pipe Covering.

Tests and Paper on Theory of Automatic Syphons.

Report on Heating and Ventilation, State Insane Asylum, Norristown.

Report on Utilization of Furnace Slag for Sewerage Purification.

Improvements in Water Closet Ventilation.

Tests and Reports on Ventilation Fans.

Report on Validity of Sterling Boiler Patents.

PHILADELPHIA.

Report on New System of Elevators for Drexel Building.

Report on Minimum Flow of Schuylkill River.

Intercepting Sewerage System for the Entire City.

Report on Locating Reservoir to Supply Middle Water System.

Improvements to the regimen of the Delaware and Schuylkill Rivers for betterment of the Port of Philadelphia, Its Water Supply and Sewage Disposal.

Paper on Economic Relation of Pumping *vs.* Gravity Water Supply as it Applies to Philadelphia.

Report and Estimate for Proposed Fire Pipe System.

Discussion on Failure of West Abutment of Chestnut Street Bridge.

Philadelphia & Reading Terminal Railroad.
Plans, Specifications and Estimates for Ventilating Subway Tunnel.

Sundry Publications and Addresses on the Waste of Water in Philadelphia.

Oro, Arizona.
Gold Placer Mines.

Ridley Park.
Street Grades, Lines, etc.

Mocanaqua Coal Co.
Survey of Land and Coal Mines.

Chiques Road.
Survey and Construction.

Decatur, Ala.
United States Rolling Stock Co. Report for Location.

Delaware Co., Pa.
Asbestos Mines.

Examinations and Report on Site for New Philadelphia County Prison.

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Report on Elevator Wreck.

Member of Committee of Franklin Institute awarding "Elliott-Cresson" Gold Medal to Pelton Water Wheel.

RAILROADS

Allentown Railroad.—Assistant Engineer—Location and Construction.

Baltimore & Ohio Short Line to Chicago.—Engineer in Charge—Surveys. Tiffin, Ohio, to Chicago.

Brigantine Railroad.—Chief Engineer—Surveys and Location.

Elizabethtown, Lexington & Big Sandy Railroad.—Assistant to Chief Engineer—Surveys and Location.

Fairmount Park Gravity Railroad.—Chief Engineer—Surveys, Location, Plans and Specifications, Estimates, etc.

Hanover Junction & Susquehanna Railroad.—Engineer in Charge of Construction.

Lebanon & Pine Grove Railroad.—Assistant Engineer—Location and Construction.

Jersey Shore, Pine Creek & Buffalo Railroad.—Assistant Engineer—Surveys.

New Orleans & Selma Railroad.—Principal Assistant Engineer—Location and Construction.

Philadelphia & North Branch Railroad.—Assistant Engineer—Surveys and Location.

Philadelphiia Belt Line Railroad location.

WATER WORKS

BALTIMORE, MD.

Report on Cause of and Remedy for Fouling of Water in the Storage Reservoirs for Water Supply.

CAIRO, ILL.

Survey—Estimates and Report for Water Works.

CAMDEN, N. J.

Report on Flow of Water from Artesian Wells.

CATHOLIC PROTECTORY, MONTGOMERY COUNTY, PA.

Water Works and Purification Plant.

HUNTINGTON, PA.—REFORMATORY.

Water Works.

JENKINTOWN, MONTGOMERY COUNTY, PA.

Water Works.

Location of Oak Lane Reservoir, Philadelphia.

Location of Torresdale Coagulation and Subsidence Reservoir.

PHILADELPHIA WATER DEPARTMENT.

Principal Assistant Engineer, 1875-1884.
East Park Reservoir.
Frankford Water Works.
Spring Garden Works, Extension.
Belmont Works, Extension.
Roxborough Works, Extension.
Mt. Airy Works, Extension.
Cambria Reservoir, Survey and Plans.
Mt. Airy New Reservoir, Survey and Plans.
Redistribution of Water Supply.
Topographical Map of Philadelphia.
Survey and Estimates for Gravity Supply, from Perkiomen and Delaware Water Gap.

PRESIDENT AND GENERAL MANAGER.

Mount Vernon Water & Power Company, Mount Vernon, Wash.

RED BANK, MONMOUTH COUNTY, N. J.

Water Works.

RIDLEY PARK, DELAWARE COUNTY, PA.

Water Works.

TACOMA, WASH.

Survey and Report for Gravity and Pumping Water Supplies.

WYOMING VALLEY WATER WORKS.

Survey—Estimates and Report for Water Supply for Entire Valley.

Whopwallopen Water Power.

Also Water Works for Various Institutions. Noted under Power Plants, etc.

DRAINAGE AND SEWERAGE SYSTEMS

Beach Haven, N. J.

Catholic Protectory, Montgomery County, Pa.

John H. Converse, Esq., Rosemont, Pa.

J. R. Whitney, Esq.

Ridley Park, Pa.

State Insane Asylum, Wernersville, Pa.

Torresdale, Philadelphia.

Plans and Specifications.

Also, Plans and Specification for Sewerage System and for Various Buildings and Institutions. Noted under Power Plants, etc.

POWER PLANTS, ETC.

Academy of Natural Sciences, Philadelphia.
Heating and Lighting.

Allentown Station, Lehigh Valley Railroad.
Heating and Lighting.

Art Club of Philadelphia.
Boilers and Electric Light Plant.

Cathedral, St. Peter and St. Paul, Philadelphia.
Plans and Specifications for Heating and Ventilation.

Catholic Protectory of Philadelphia, Montgomery County, Pa.
Electric Light and Power Plant. Heating and Ventilation. Water Works and Filtration. Drainage and Sewerage Systems. Water Works Operated by Compressed Air.

Convalescent Home, Devon, Pa. Heating.

Cottage Hill, Carlisle, Pa. Residence, etc., F. C. Bosler, Esq.
Central Plant, Heating Buildings, Green Houses, etc.

Deaf and Dumb Asylum, Mt. Airy, Philadelphia.
Central Power Plant. Heating and Ventilation. Electric Lighting. Water Supply.

Drexel Building, Philadelphia.
Electric Light and Power Plant. Heating and Ventilation. Water Works. Sewerage and Drainage. Elevators.

Drexel Building, Philadelphia.
New Switchboards, New Dynamos.

Drexel Institute, Philadelphia.
Electric Light and Power Plant. Heating and Ventilation.

Drexel Institute, Philadelphia.
Report Estimate Extension of Electric Plant, Plans and Specifications.

Easton Station, Lehigh Valley Railroad.
Heating and Lighting.

Equitable Trust Company, Wilmington, Del.
Boilers and Heating Plant.

German Hospital, Philadelphia.
Power Plant. Boilers. Engines, Dynamos. Water Works. Filtration, etc.

Philadelphia & Reading Railroad Terminal Station at Harrisburg.
Plans and Specifications for Heating.

Home for Widows and Indigent Single Women, Philadelphia.
Heating and Ventilation.

Horstmann Building, Philadelphia.
Heating, Buildings No. 2, No. 2a, No. 2b. Plans and Specifications

Horticultural Hall, Philadelphia.
Modification of Heating and Ventilation.

Industrial School of St. Francis de Sales, Eddington, Pa.
Electric Light Plant. Heating and Ventilation. Water Works.

Industrial Training School, Indianapolis, Ind.
Heating, Ventilation, Lighting, etc.,

La Moille Hydro-Electric Power Plant.

Moyamensing Prison, Philadelphia.
Electric Plant.

Philadelphia Commercial Museum.
Power House and Preliminary Plans for Power Plant, etc.

Philadelphia County Prison, Holmesburg, Pa.
Electric Light Plant. Heating and Ventilation. Sewerage and Drainage Systems. Water Works.

Philadelphia Dental College.
Electric Lighting, Heating and Ventilation.

Philadelphia Hospital, Insane Department (Extension).
Heating and Ventilation.

Philadelphia and Reading Terminal Station and Railroad.
Electric Light and Power Plant. Heating and Ventilation. Water Works. Refrigeration Plants and Cold Storage Rooms. Elevators.

Presbyterian Hospital, Adms. Building, West Philadelphia.
Heating, Lighting and Ventilation.

Presbyterian Hospital.
Heating, Ventilation and Lighting of Dulles Ward, Hutchinson Ward.

Professional Building, Philadelphia.
Electrical Lighting and Power. Heating and Ventilation. Water Works and Filtration.

Real Estate Trust Company, Fifth and Chestnut.
Heating and Electric Light Plant.

Residence, J. H. Converse, 1616 Locust.
Electric Lighting, Heating and Ventilation.

St. Andrew's Church, West Philadelphia.
Chancel, Electric Lighting and Heating.

St. James's Church and Guild House, Philadelphia,
Electric Lighting, Heating and Ventilation.

St. Vincent's Home and Maternity Hospital.
Heating and Ventilation.

The Baldwin (Hotel), Beach Haven, N. J.
Heating.

Trust Company of North America.
Electric Light Plant. Heating. Elevators.

United Gas Improvement Company, Office Building.
Heating and Ventilation. Electric Light and Power Plant. Water Works. Drainage. Elevators. (Gas Engines with Electric Distribution of Power.)

University of Pennsylvania.
Central Power Plant and Heating and Ventilation of College Hall, Medical Hall, Dental Hall and the Mechanical Building.

University of Pennsylvania.
Gymnasium, Power Plant, Heating, Ventilating, Electric Light and Power, Water Purification and Heating, etc., for swimming pool, etc.

University of Vermont.
Williams Science Hall—Electric Lighting, Heating and Ventilation. Converse Hall—Electric Lighting, Heating and Ventilation

U. S. Mint, Philadelphia.
New Boilers, Engines and Shafting.

Williams Building, Detroit, Mich.
Electric Lighting, Heating and Ventilation.
Etc., etc., etc.

PROFESSIONAL OPINIONS

OPINION

OF

JAY M. WHITHAM, M. A., C. E., M. E.

Member of Am. Soc. Mech. Engineers
Am. Soc. of Naval Arch. & Marine Engrs.
Am. Soc. of Naval Engineers
New England Water Works Association
Late Assistant Engineer, U. S. Navy

CONSULTING ENGINEER

PHILADELPHIA

Office of
JAY M. WHITHAM, M. E.,
Consulting Engineer,
607 Bullitt Building.

Philadelphia, October 18, 1912.

MR. CHARLES G. DARRACH,
Consulting Engineer,
Philadelphia, Pa.

DEAR SIR:—In your paper relating to "The Appraisal of Public Utilities" you have blazed a new trail and presented an old subject in attractive form. I think that you are on the right path and that the engineering fraternity should appreciate your efforts.

The valuation of public utilities has been a subject of controversy for fifteen years or longer, and up to the present time no one is satisfied with the methods which have been used.

Your large experience with public utilities and your great range of practice in engineering specially qualify you to speak upon this subject with authority. It is unfortunate that engineers possessing special and peculiar knowledge are not more inclined to submit papers of interest for their brothers.

Yours very truly,
JAY M. WHITHAM.